PATENT

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Examiner:	Hwei-Sui Payer
Applicant:	Zhang et al.
Title:	CUTTING DIE AND METHOD OF FORMING
Atty. Docket:	BERL-18A

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

DECLARATION OF NONOBVIOUSNESS
UNDER 37 C.F.R. §1.132

I, Dr. C. Rey Hsu, hereby state and declare the following:

I received a B.S. in 1981 and a M.S. in 1986 in Physics, with an emphasis in laser optics, from Fu-Jen Catholic University in ____. I received a M.S. in June 1991 and a Ph.D. in 1996 in Welding Engineering from The Ohio State University, with a major in Laser Materials Processing and Minors in Weld Design and Electrical Engineering. I am a member of the following professional organizations: American Welding Society, Laser Institute of America, Fabricators and Manufacturers Association International, IEEE, Peer Review Committee of the Journal of Taiwan Cutting and Welding, Peer Review Committee of the Gulf Coast Maritime Technology Center of the University of New Orleans, and visiting professors at Harbin Research Institute of Welding in China. I have published over 30 articles in laser weld and cutting areas, hold 2 patents, and have two pending patent applications.

I am a General Manager for Focal Laser Innovative Solutions, LLC, which is in the business of development and implementation of laser technologies to a wide range of

applications. I have been in this position since 1999. From 1997 to March 2001, I was Senior Project Manager for the Laser Welding and Cutting Group of Fraunhofer USA, Center for Laser Technology. For two years prior to that, I was Project Manager in the same group. From 1988 to 1995 I was a Graduate Research Associate at the Ohio State University. In 1987, I was a Design Engineer for Delta Electronic Industrial Inc., and from 1985-1986 I was an Optical R&D Engineer for Pacific Laser Electro-Optics Inc. Through my education and professional endeavors, I have developed expertise in the following areas: Laser Welding, including that commonly used on the Photonics industry for glass-to-silicon welding; laser materials processing, welding metallurgy, laser training, and laser optics.

After careful review of Bernal's pending patent application serial no. 08/602,379 entitled "Cutting Die and Method of Forming", Tanaka et al. U.S. Patent No. 5,361,968 and the articleXP000604533 by Murphy et al., I make the following comments based on my education, knowledge and industrial experience in the laser processing and welding fields:

1. Bernal's pending patent application discloses a laser cladding process, while Tanaka's patent discloses a welding process. Welding processes generally involve a large amount of heat being induced in the materials in the surrounding area of the weld, resulting in distortion and cracking to the product. The welding process also induces a large amount of residual stress in the die body and blade, which can cause cracking and corrosion. Distortion and residual stress also will cause the blade to actually move during operation of the cutting die, which causes tolerance problems. I believe the laser cladding process disclosed in the application provides a solution to these technical difficulties. The laser induces only a small amount of localized heat at

the surface of the die body, causing little to no distortion of the surrounding area, and inducing little to no residual stress.

2. The laser cladding process disclosed in the pending application is an accurate, highly controllable deposition process that is capable of producing a near net shape. Near net shape is a term of art referring to a shape that is close to the final desired shape, and which requires only a small amount of material removal. Welding on the other hand involves large, wide beads of deposited material that are hard to control with respect to defining a precise shape and providing accuracy and consistency. To produce a blade by welding, the deposited material must be subjected to significant machining after deposition due to the general messiness of the process. Laser cladding as disclosed in the application requires only modest machining to define the blade from the deposit due to the near net shape capability of laser deposition. Tanaka needed to deposit a soft material and machine it prior to hardening due to the significant machining required by virtue of using a welding process. For a cutting die produced in accordance with the pending application, a hard material may be deposited and machined due to the low amount of machining required with a near net shape deposit.
3. Bernal's pending patent application proposes to form blades from materials with a much higher content of carbides (for example, 20% in D-2 Steel) and harder carbides (chromium, vanadium and tungsten carbides) due to the high wear resistance and long life required for the die cutting application. Tanaka's welding process is not able to deposit alloys with a high volume percentage of hard carbides on dies effectively and successfully. A significant amount of cracking

occurs in the die body and blade when high alloys are deposited by known welding techniques such as described in the Tanaka et al. patent.

4. With respect to rotary dies, the patent application represents a new process to make rotary dies, while Tanaka's invention provides a method for building up the shear edges of trimming press dies. The rotary dies are very different from the trimming press dies. A rotary die typically contains more complicated cutting patterns, including intersecting or crossing blades, for example, formed on a curved surface of a cylindrical body. The blade for a trimming press die is structurally simple, forming an edge of a flat, rectangular body. In the Tanaka patent, the weld deposit is applied to a flat surface with no complexity in pattern. The production process for rotary cutting dies is totally different as a result of forming a complex pattern on a curved surface.

5. As to the article "The Rapid Manufacture of Metallic Components by Laser Surface Cladding", by Murphy et al., this article is a very general introduction to a new concept of laser rapid prototyping. Murphy et al. are emphasizing how to form the shape on substrates using laser powder deposition of similar materials with low hardness and low alloys. This is again different from what Bernal's patent application is providing. The laser deposition in the pending application provides 2-D patterns with high carbide-content alloys for functionality, whereas the laser rapid prototyping mentioned in Murphy's article is mainly dealing with 3-D patterns. And the laser rapid prototype process is not able to use high alloys required for die cutting applications due to various metallurgical difficulties. Murphy discloses using cobalt powder to clad onto a cobalt plate or using 314

stainless steel to clad onto a 314 stainless steel plate, both of which are very pliable and soft. They do not have the wear resistance required to function in the context of a rotary cutting application. As one skilled in the art of lasers, I would not have read the Murphy et al. article and concluded that blades on cutting dies could be achieved as disclosed in the application.

6. The combination of Tanaka's patent and Murphy's article fails to provide a process solution to rotary die manufacturing that applies a high alloy to a soft, dissimilar material die body and post-cladding machining of near net shape beads into cutting blades. In my opinion, the invention that is the subject of the application was not an obvious solution for the cutting die industry.

Further Declarant sayeth naught.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: _____

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